PROPOSED

INDIAN RIVER CANOE TRAIL

Submitted by

THE OTONABEE REGION CONSERVATION AUTHORITY

to

THE MINISTER OF AGRICULTURE AND FOOD

and

THE MINISTER OF ENERGY AND RESOURCES MANAGEMENT

January, 1968

CONTENTS

I STATUTORY REFERENCES

(a) The Conservation Authorities Act, 1960, c. 62 as amended, b ut more specifically:

(i) Section 16
(ii) Section 42

(b) The Agricultural Rehabilitation and Development Act, 1965 as amended, but more specifically the Rural Development Agreement 1965-1970, Part VIII, Section 42 (1).

II DETAILS OF SCHEME

1. PROPOSED CANOE ROUTE

(a) Location

The Indian River, which runs between Stony Lake and Rice Lake, is located in a popular summer resort and holiday region and is within easy travelling distance of several large centres of population.

The Kawartha Lakes have already established the region as a first rate vacation area. Dummer Lake (known locally as White Lake) is heavily populated with cottages, mainly on the west side. The lands adjacent to the Indian River, however, are quite undeveloped with only a few cottages. The natural setting along the river varies from high rock cliffs or dense natural forest to pleasant rolling farmland.

The villages of Warsaw and Keene and the four existing mills and dams add to the beauty and provide historical significance. An early grist mill and one sawmill are still in operation.

The Warsaw Caves Conservation Area is a popular attraction along the river. Not only does it add to the attraction of a canoe route, but the canoe route would in turn increase the popularity of the conservation area. Camping facilities have already been developed in the area.

Other scenic areas include two small private parks as well as the Lang Mill Conservation Area along the river and the Serpent Mounds Provincial Park at Rice Lake. There is potential for the development of many more parks and camping areas.

Highway No. 7 and two railway lines, C.N.R. and C.P.R., cross the river. The number of roads near the river adds to the development possibilities of the river since they allow excellent access to almost any point. The location, therefore, is ideal for the development of a water route for light boats.

The stream profile and channel conditions are discussed in detail in Chapter 2.

(b) Water

Under present conditions the depth of water in the Indian River drops to less than 6 inches in numerous reaches. Many of these reaches contain large rocks and boulders.

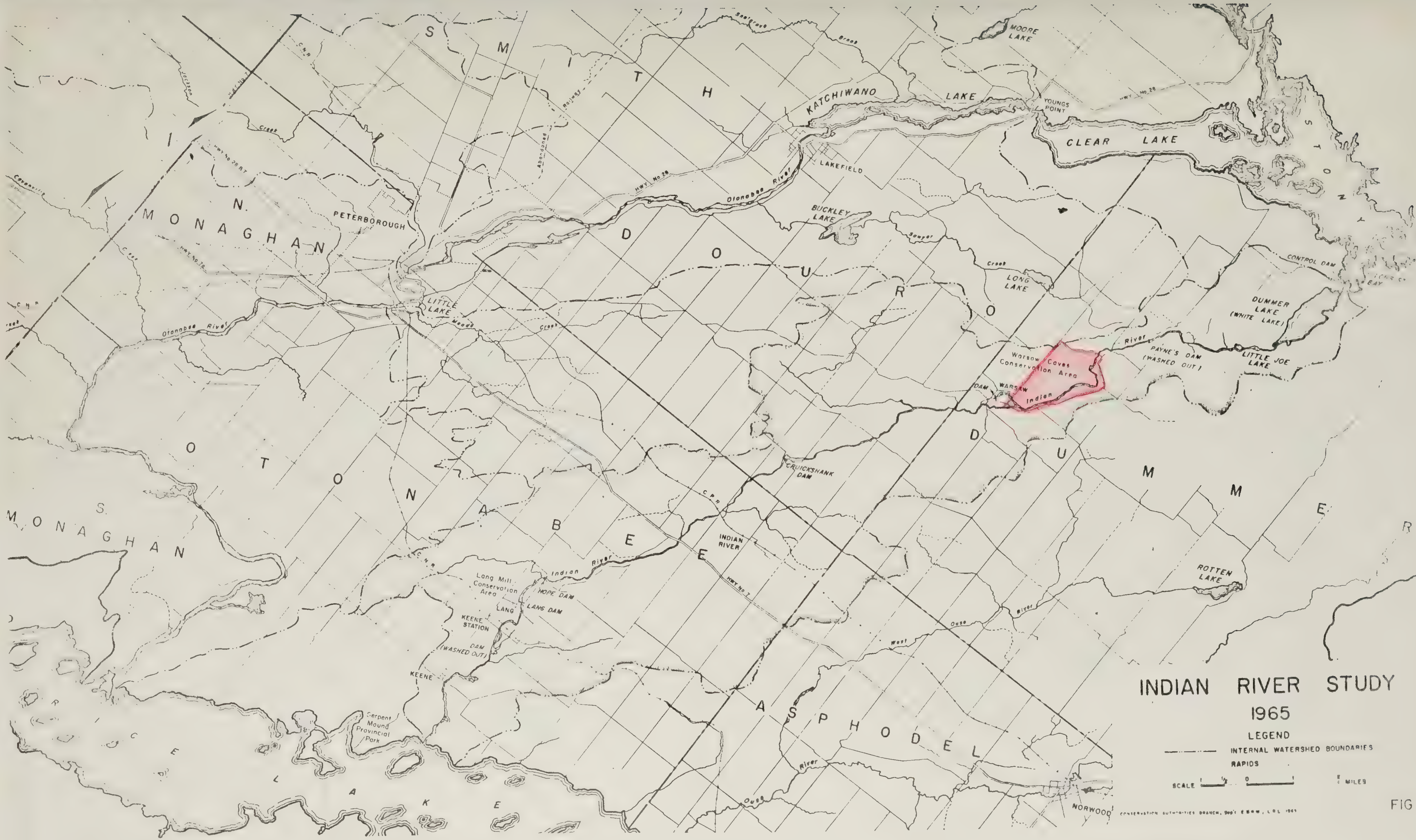
Where a stream is subject to low flows or contains numerous and long shallow reaches, the prime problem considered in planning to establish a canoe route is the depth of water.

Four conditions which could create difficulties for the canoeist are:

(1) direction of his travel,
(2) current,
(3) bottom conditions,
(4) size and loading of canoe.

The direction of travel is important because it is more difficult to paddle upstream than downstream. The current in the stream and bottom conditions must also be considered in this regard. If the stream bottom is free from sharp rocks the canoe may be able to pass safely through shallow areas.

The size and canoe loading affect the draft of the canoe. A canoeist on a trip for a week will carry a larger supply of gear and food than a day canoeist. The larger



INDIAN RIVER STUDY
1965
LEGEND
INTERNAL WATERSHED BOUNDARIES
RAPIDS
SCALE
MILES
SMITH
DOURO
DUMMER
OTONABEE
ASPHODEL
N. MONAGHAN
S. MONAGHAN
RICE LAKE
MOORE LAKE
KATCHIWANO LAKE
YOUNGS POINT
CLEAR LAKE
STONY
LAKEFIELD
PETERBOROUGH
LITTLE LAKE
BUCKLEY LAKE
LONG LAKE
CONTROL DAM
DUMMER LAKE (WHITE LAKE)
LITTLE JOE LAKE
PAYNE'S DAM (WASHED OUT)
Warsaw Caves Conservation Area
WARSAW
DAM
Indian River
CRUICKSHANK DAM
INDIAN RIVER
C.P.R.
HWY No 7
HWY No 28
Otonabee River
Long Mill Conservation Area
HOPE DAM
LANG DAM
LANG
KEENE STATION
DAM (WASHED OUT)
KEENE
Serpent Mound Provincial Park
ROTTEN LAKE
West Ouse River
Ouse River
NORWOOD

FIG I

load will make the handling of the canoe in shallow water much more difficult. Portaging will also be more difficult.

Based on the above considerations and preliminary investigations the minimum depth of water required for developing a canoe trail was established at <u>one foot</u>. It is recommended that this criterion be adopted by the Authority.

Although a canoe could pass in many sections safely with a depth of 6 inches, one foot was adopted since it will allow for better control of the canoe and at the same time provide for more enjoyable canoeing.

(c) <u>Proposed Canoe Trips</u>

The Authority at present has selected four trails for preliminary investigations. Further investigation and study of such factors as travelling time, portages, the public's preference for length of trail and return trip to starting point will be required.

TABLE I
PROPOSED CANOE TRIPS

Trip No.	Designation	Trip	Distance Miles	Remarks
1	<u>One Day</u>	Dummer Lake to the Warsaw Cons. Area	6	
2	<u>Two Day</u>			
	1st day	Dummer Lake to mid-Douro Township	13	
	2nd day	mid-Douro Township to Rice Lake	13	
3	<u>Two Day</u>	<u>Dummer Lake to Pbo.</u>		
	1st day	Dummer Lake to Rice Lake	26	Trip would require continuous hard canoeing
	2nd day	Rice Lake to Peterborough via Otonabee River	26	
4	<u>Round Trip</u>			
	Time varies	Indian River - Otonabee River - Clear and Stony Lakes	80	Less than one week of travel time

The one-day trip could easily be completed within the day, allowing sufficient time for picnicking and returning to Dummer Lake. The two-day trip from Dummer Lake to Rice Lake also h as been established as a leisurely trip allowing ample time for camping for an average canoeist.

The trail from Dummer Lake to Peterborough has been selected for the ardent canoeist and would require continuous hard canoeing to complete the trip in daylight hours. The overnight stop could be made at the Provincial Park, Serpent Mounds, located on Rice Lake.

The round trip would start and end at Dummer Lake. It would be designed for the canoeist who desires to spend the better part of a week on water.

2. PHYSICAL CHARACTERISTICS

(a) Watershed

The Indian River, located roughly six miles east of Peterborough, flows in a southerly direction from Stony Lake through Dummer Lake to Rice Lake. Locally, Dummer Lake is known as White Lake. At the village of Warsaw the river enters a drumlin field and follows a gently winding course. The watershed area is difficult to determine because of drainage pattern of the drumlin field, but is approximately 100 square miles. It is a long narrow area, 22 miles in length from north to south and varying in width from approximately one mile at the Warsaw Conservation Area to about five and a half miles in the vicinity of No. 7 Highway crossing.

About 1835 a "cut" was made between Stony Lake and Dummer Lake at Gilchrist Bay to provide additional flow in the Indian River. The flow from Stony Lake is controlled by a small dam located at Gilchrist Bay. Operated by the Trent Canal office, the practice has been to maintain a minimum discharge of 40 to 60 c.f.s. down the Indian River.

(b) Agricultural Land Use Capability

The Potential Agricultural Land Use Capability of the area within the Indian River Watershed is categorized in eight different classes. The following chart shows a breakdown of these classes, along with the actual area of the watershed and the percentage of the total area of the watershed affected by each class.

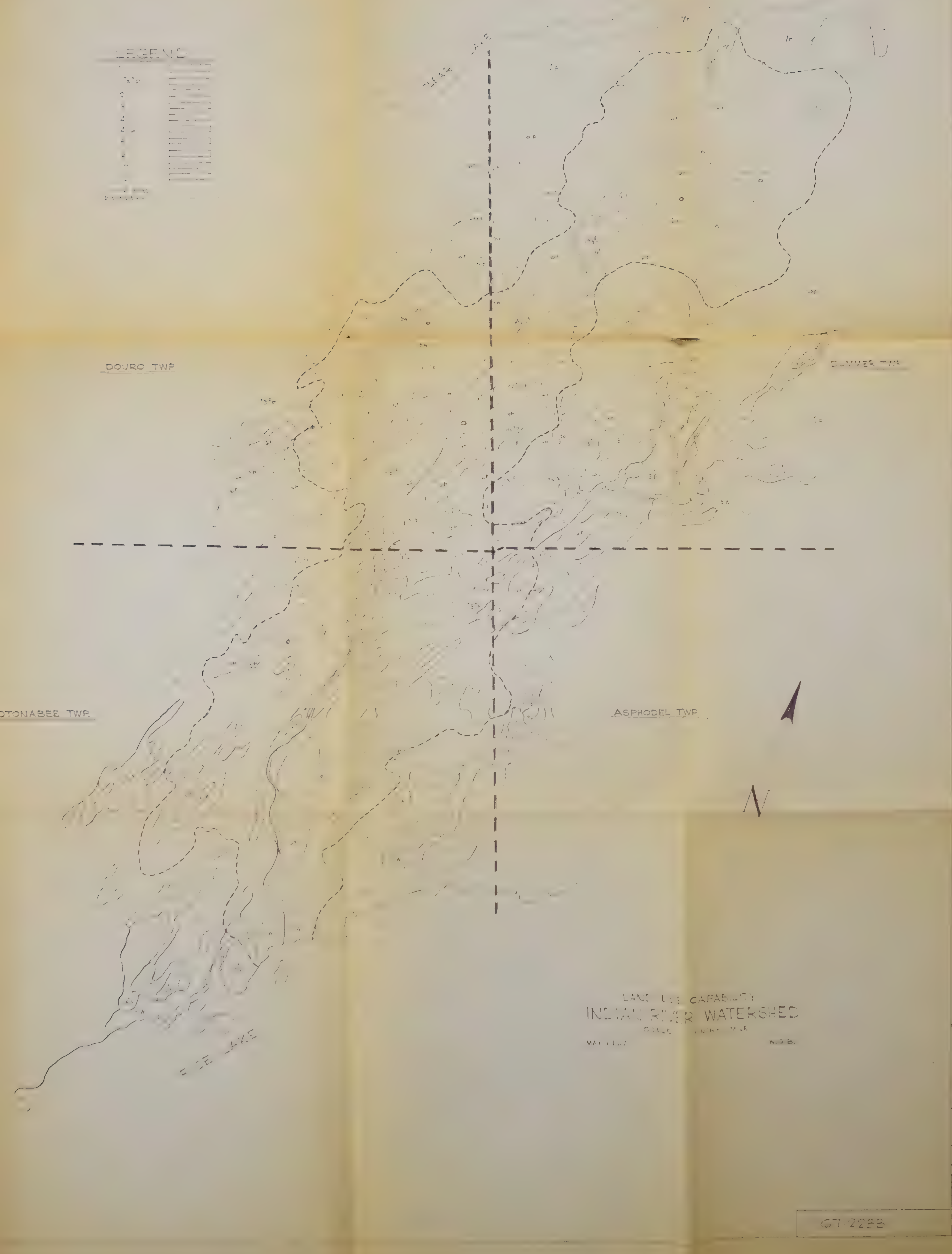
TABLE II

CLASS	SQUARE MILES	PERCENT
1	1.95	2.23
$1^7 3^3_p$	38.78	44.38
2	0.28	0.32
3	5.22	5.97
4 - 6	0.34	0.39
6	25.92	29.64
7	1.36	1.56
0	13.42	15.40
Dummer Lake	0.10	0.11
TOTAL	87.37 square miles	100.00

From Table II, class $1^7 3^3_p$ makes up the largest area of the watershed - a total of 38.78 sq. miles or over 44%. This is a complex class of agricultural land use capability which can be described as being approximately 70% class 1 land and 30% class 3 land because of severe slope, and subsequent erosion and stoniness. Therefore, 30% of the above area is subject to severe limitations for agricultural production and should be maintained in pasture at least 75% of the time.

Class 3 land areas are restrictive to agricultural use due to imperfect or poor drainage, but with installation of tile drainage potential production could be improved.

Class 4 - 6 is a complex class where a combination of droughtiness and shallowness interspersed with hummocky areas of sand and shallow sand over bedrock allows for only occasional agricultural production. An alternate use for this land should be found, such as forestry, which would provide greater returns to the landowner.


LEGEND
DOURO TWP
OTONABEE TWP
ASPHODEL TWP
N
CAPABILITY
WATERSHED
W. B.
GT-2288

About 30% of the area is class 6 where generally the depth of topsoil over bedrock is less than one foot. This land is generally not useful for agriculture except for light grazing.

Of the class 7 land in the Indian River Watershed, about half is bare bedrock, the remainder, areas of marsh. There is no agricultural production carried on here, but such areas are suitable for wildlife habitat.

As can be seen from the chart, 46.23 sq. miles of the watershed have lands in which the agricultural land use capability class is class $1^7 3^3_p$, 2 or 3. This accounts for almost 53% of the total land area of the watershed. The remaining 41.04 sq. miles of the watershed have land classes 4, 6, or 7 and class 0 which refers to organic soils such as muck or marsh. The area of class 4 or worse covers about 47% of the watershed.

(c) River

(i) General

The Indian River is approximately 26 miles long with a total fall of 155 feet or an average gradient of 5.9 feet per mile. There are numerous shallow sections and rapids covering more than three miles where the normal depth of water is less than six inches. The average width of the stream is approximately 100 feet.

The survey found evidence of six mill dams, four are still in operation. At the more scenic spots private cottages and some permanent homes have been built. In these areas the river is generally deep and wide and provides excellent boating and swimming.

For descriptive purposes, channel profiles and mosaics of the river are given on Figures 2, 3 and 4. The reaches which require detailed consideration for improvement have been indicated in red on the profile, and identified by number for reference when discussing remedial measures.

The distance along the centre line of the river is shown in hundreds of feet starting at Rice Lake, and the river has been divided into three parts each of which has been subdivided into a number of smaller reaches.

(ii) Part I

Part I, shown on Figure 2, extends from Stony Lake to the village of Warsaw. The elevation of Stony Lake is 768 feet. The distance is approximately eight miles and there is a fall of roughly 60 feet from Dummer Lake (elevation 763 feet) to the pond at Warsaw (elevation 703 feet).

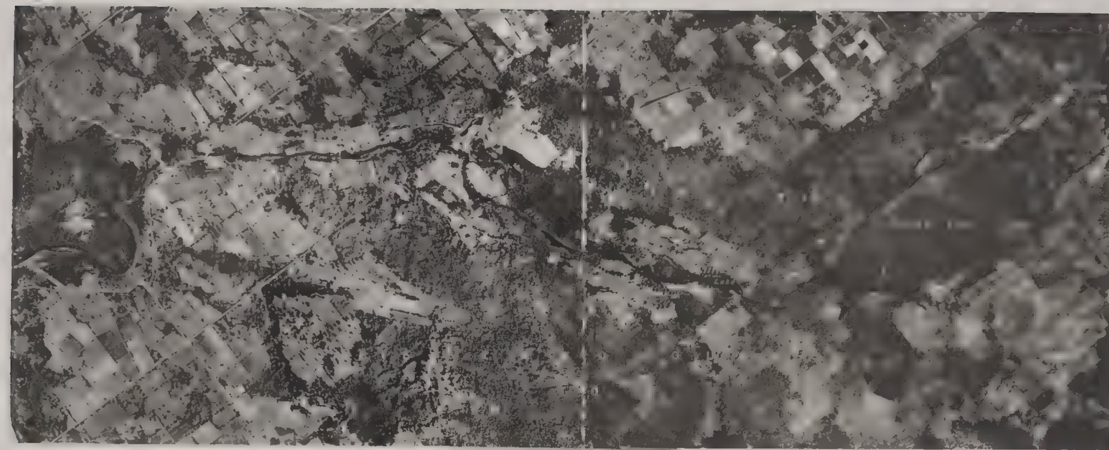
This part includes the most scenic and picturesque reaches of the river. At the same time, it also has long shallow stretches which will require extensive remedial measures in developing a canoe route.

The first shallow reach, marked 1 on the profile, occurs immediately below the control dam at Stony Lake. Since the canoeist would have to portage around the dam, this reach does not present any difficulty.

Although quite shallow in certain areas, Dummer Lake provides excellent canoeing. Motorboats are forced to use definite channels to avoid running aground.

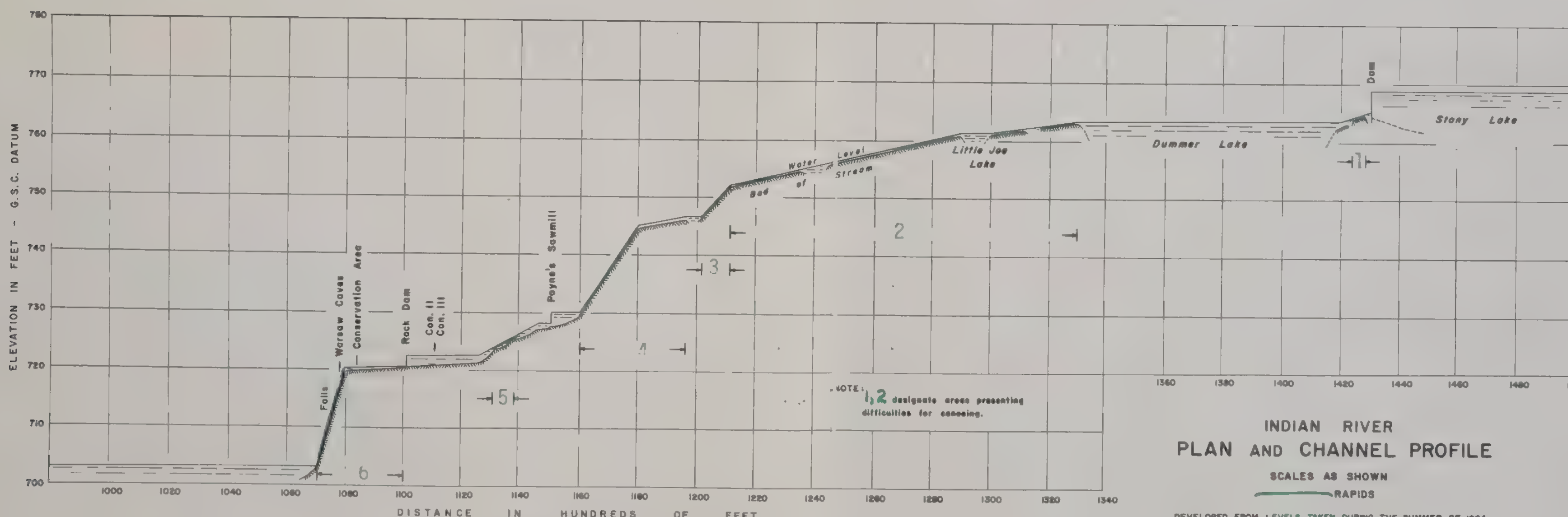
From Dummer Lake to Payne's pond the Indian River is generally shallow and wide with a flat limestone bottom. There are numerous small boulders and stones in the river. In some areas the current is swift and creates standing waves as the water flows over the stones and boulders.

Illustration 1 is typical of the river in this section. There are no river banks of any significance and the river flats are quite broad. In some cases the flats consist of low, swampy areas.



PLAN

SCALE 1320 660 0 1320 2640 FEET



CHANNEL PROFILE

INDIAN RIVER

PLAN AND CHANNEL PROFILE

SCALES AS SHOWN

RAPIDS

DEVELOPED FROM LEVELS TAKEN DURING THE SUMMER OF 1964.

CONSERVATION AUTHORITIES BRANCH, Dep't. E.&R.M., L.R.L. 1966

FIG. 2

Reach 2 includes two short, difficult areas between Dummer Lake and Little Joe Lake, a shallow stretch extending 4,000 feet downstream from Little Joe Lake to end in a deep pool, and the upper 1,600 feet of the next rapids below the pool.

The next trouble area, Reach 3, comprises the remaining 1000 foot portion of this rapid which has a much steeper gradient.

About 500 feet downstream is another difficult reach, 4, extending 3,800 feet to Payne's sawmill pond.

The pond created by Payne's dam extends roughly a thousand feet downstream from this point. Two small trouble spots, Reach 5, are found between here and a low rock dam just above the Warsaw Caves Conservation Area.

Another shallow reach 6, extends downstream to the falls located in this Conservation Area. Illustration 2 shows the character of the falls, which consist of large blocks of limestone strewn along a steep incline. During periods of high flow the falls are very scenic. Deeper water prevails from the falls to Warsaw.

(iii) Part II

The nature of this portion of the river is shown on Figure 3. At Warsaw the natural river bed is located to the east of the main dam and pond. The flow is diverted from the natural channel into the pond by a two and one-half foot high concrete weir. During the summer there is only a small flow down the natural channel. It has been identified as Reach 7.

From the village of Warsaw to the Cruickshank Dam, the river offers good canoeing with the exception of a small trouble spot, Reach 8, south of the road between lots 6 and 7, Douro Township. This shallow reach is less than a thousand feet in length.

1

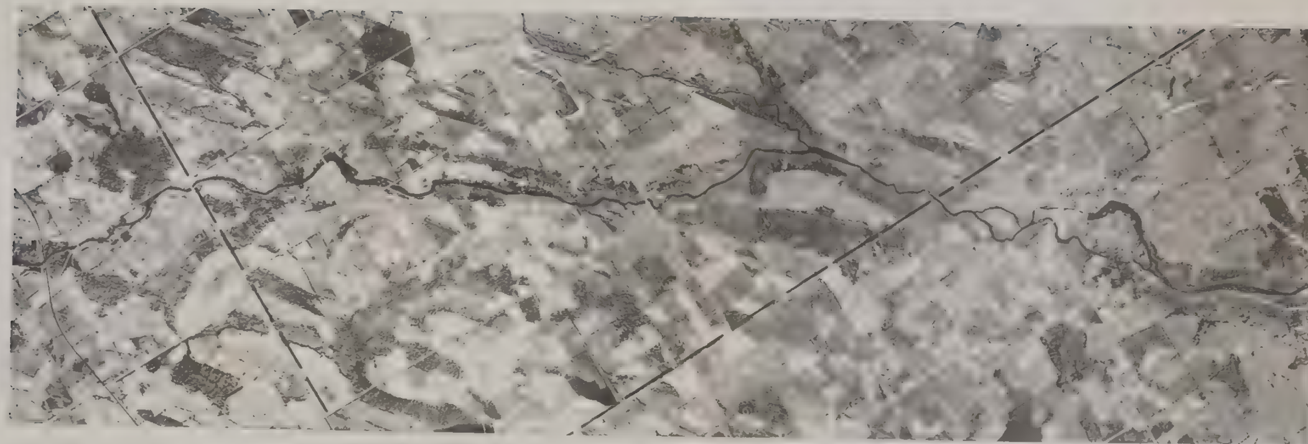
The river between Dummer Lake and Payne's sawmill.

2

The Falls at the Warsaw Conservation Area.

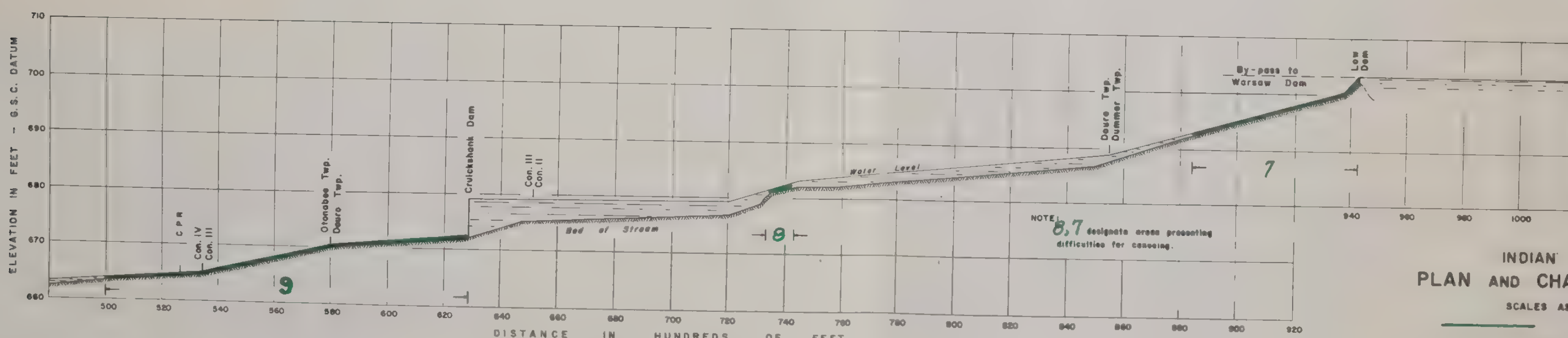
3

Between Warsaw and the Cruickshank Dam.



PLAN

SCALE ... FEET



CHANNEL PROFILE

INDIAN RIVER

PLAN AND CHANNEL PROFILE

SCALES AS SHOWN

RAPIDS

DEVELOPED FROM LEVELS TAKEN DURING THE SUMMER OF 1964.

CONSERVATION AUTHORITIES BRANCH, Dep't. E.&R.M. L.R.L. 1965

FIG. 3

Illustration 3 is typical of the river below Warsaw. The lands on both sides of the river are flat, swampy and densely forested, with tall elms and cedars overhanging the river. Here and there fallen trees lie across the stream.

The most difficult reach, 9, occurs below the Cruickshank Dam. It is approximately two and one-half miles long with a fall of roughly nine feet. The nature of this reach is shown on Illustration 4.

(iv) Part III

Part III, shown on Figure 4, extends from a point 4,000 feet north of Highway No. 7 to the mouth of the Indian River at Rice Lake, a total distance of approximately nine and a half miles. Included in this section are the Hope and Lang Dams and the remains of an abandoned dam below Keene Station.

The first shallow reach 10, is quite flat. It starts at Highway No. 7 and extends a short distance downstream.

The next 11, is approximately a mile long with a fall of seven and one-half feet. As shown in Illustration 5, the river here is wide with low banks. Below this reach, for 7,500 feet,good canoeing is provided by the pool created by the Hope Dam.

A short shallow reach 12, occurs just below the Hope Dam, and another pool, 4,000 feet long, behind the Lang Dam.

The next two reaches, marked as 13 and 14, run downstream from the Lang Dam for a combined distance of approximately 7,500 feet and have a total fall of 10 feet. The river here is wide and shallow, with numerous boulders and stranded timbers. This section extends nearly to the abandoned dam below Keene Station.

Below the abandoned dam is a similar shallow reach 15 about 4,200 feet in length. The nature of this stretch is shown in Illustration 6. This is the last section requiring remedial work.

4

Looking upstream from the railway bridge Con. IV, Otonabee Township. Reach 9 in the channel profile.

5

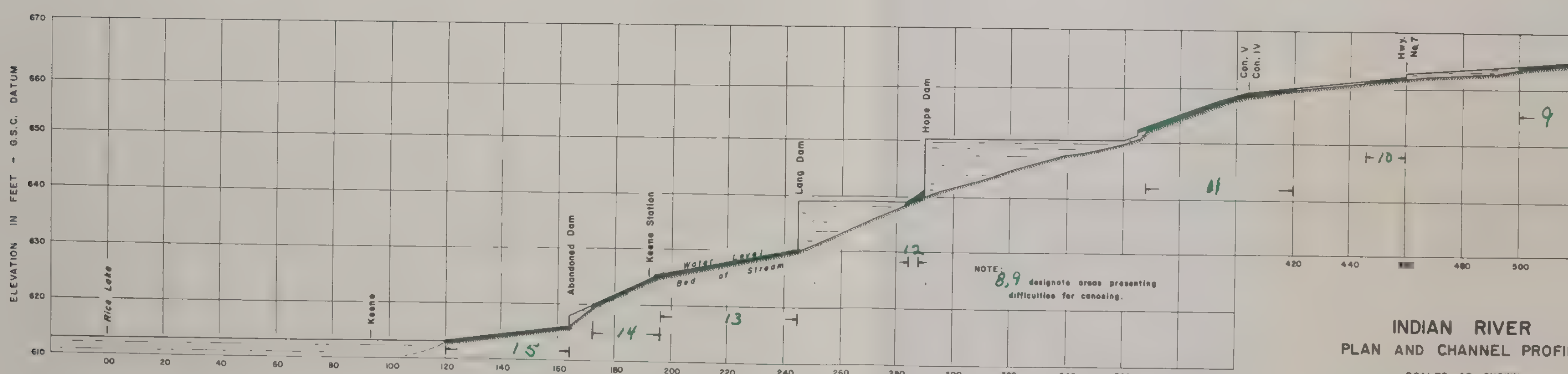
South of Highway No. 7 in Con. V, Reach 11 on the channel profile.

6

Downstream from the washed-out dam at Keene. The river is wide and shallow with numerous boulders. Reach 15 on the channel profile.

PLAN

SCALE 1320 660 0 1320 2640 FEET



DISTANCE IN HUNDREDS OF FEET

CHANNEL PROFILE

INDIAN RIVER

PLAN AND CHANNEL PROFILE

SCALES AS SHOWN

RAPIDS

DEVELOPED FROM LEVELS TAKEN DURING THE SUMMER OF 1964.

CONSERVATION AUTHORITIES BRANCH, Dep't E.&R.M. L.R.L. 1965

FIG. 4

From here past the Village of Keene to Rice Lake, a distance of about 12,000 feet, the river has little gradient. In this area, the river is wide and fairly deep, with low and marshy banks. An island is located in the river about halfway between Keene and Rice Lake.

(d) Existing and Abandoned Mill Dams

The early settlers in this area harnessed the Indian River with a number of dams to generate power to drive their saw, flour and grist mills, and later the first electric power in the area was generated at Keene. Four of these power structures are still serviceable, but two others, of which remains are still in evidence, have been washed out in recent years. The existing dams and the remains of the abandoned dams are described briefly in the following sections.

(i) Payne's Sawmill

In Concession III, Dummer Township, exist the remains of a dam which formerly supplied power for a sawmill. The sawmill has now been relocated farther back on the western bank and is powered by a gasoline engine. Only the earth embankment of the dam remains.

Originally water flowed over a control structure located at the eastern end of the earth section. This has been filled with earth and stone, and the river flows through a six-foot wide passage cut through the earth embankment at the western end. The embankment itself appears to be in fair condition.

Immediately upstream from the old dam there are a large number of logs and dead trees lying in the river bottom. A deep accumulation of silt is also present in the old mill pond. Downstream from the dam the river is flanked on the west by a 15 foot bank of sawdust from the present sawmill. The river carries a considerable quantity of this sawdust for several

hundred feet downstream. This matter should be investigated by the proper authorities and the necessary action taken to remedy the situation.

(ii) Warsaw Dam

This small dam and pond is located in the Village of Warsaw on a bypass channel. The main river channel is located east of the village. Water is diverted into the pond by a low concrete weir located 3,000 feet upstream from the main dam.

Originally the dam was constructed to obtain water-power to operate a mill of which only the foundations and raceway remain today. The mill burned in 1962.

The dam consists of a small concrete control section and an earth fill embankment. Flood flows pass down the main river. The control section is in very poor condition and is a hazard to the public. Steps should be taken to keep small children away from the abandoned raceway or to have it repaired.

The earth embankment section has a narrow top width and only one and one-half feet of freeboard. It is largely overgrown with trees and shrubs, which is an undesirable state for dam structures.

The pond, which is over 15 feet in depth near the dam, provides considerable recreation for the local residents in the form of swimming, boating and skating.

(iii) Cruickshank Dam

Located in Concession III, Douro Township, this dam is in the best condition of all the dams on the river. The owner, a resident of Peterborough, has made considerable improvements to the dam and is presently installing equipment to develop water-power.

The spillway section has been improved by recently poured concrete faces on the east abutment and the upstream side of both piers providing new stop log slots. The short earth dikes and the main spillway structure appear to be quite sound. The river channel below the dam has been cleared out along with the tail-race.

(iv) Hope Dam

The Hope Mill and dam is located one mile up-stream from Lang. This mill is still being operated by a direct descendant of the original builder.

The mill was originally built as a flour mill, but was later converted to a sawmill by the addition of a wooden structure to the former stone building. The original wooden dam was replaced by a concrete structure which was poorly anchored and failed. This was replaced by the present structure of the same design except that it was keyed to the bedrock.

The present dam, although quite sound, has excessive leakage around the north end of the spillway. This could be stopped relatively inexpensively by a low concrete wall replacing the present earth and rubble embankment. Numerous bedrock outcrops exist near and around the mill and dam.

The mill itself would require some repair if it were to be purchased by the Authority and opened to the public. The mill appears unsafe due to deterioration in the foundation and sills. Many of the items of equipment us ed by the present owner's grandfather in the early operation of the mill are still in the building.

(v) Lang Dam

This dam and grist mill, built about 1846, in the Village of Lang, has been acquired recently by the Authority.

The dam generally is in poor condition. The wooden catwalk, stop logs and lifting mechanism are old and badly deteriorated. The concrete overflow spillway section is cracked and considerable erosion and scaling has occurred on the downstream corners and underside of the concrete piers. One pier has been tilted and shifted out of line. The above conditions are a result of the lack of proper maintenance and deterioration through age. Because of its poor condition and possible failure the Authority is undertaking some emergency repairs.

The earth dike appears quite sound, but the side slopes are steep and should be reinforced with fill and properly graded. The mill, a stone building, is in fair condition.

(vi) Dam above Keene

Between the Village of Keene and Keene Station are the remains of an old dam which provided water-power for the operation of a mill located in Keene. The mill and dam were joined by a mill-race one half-mile long. The original dam consisted of an earth dike approximately 100 yards long with stop log controlled concrete sections at each end.

The main stop log section has collapsed. The middle pier and west abutment have been dislodged and over-turned in the 20-foot wide washed-out section. The easterly abutment is still well secured to the earth dike. The control section at the east end of the dike apparently was not keyed into the flat bedrock bottom and has been swept away.

Between these sections the original earth dike appears to be in fair shape. There are some shrubs growing on the embankment and the top width is quite narrow in some areas.

3. HYDROLOGY

(a) General

The hydrologic considerations for planning the canoe route are the minimum and maximum streamflows. The minimum flows control and affect the depth of water in shallow reaches along the river and therefore are of prime concern when considering the establishment of a canoe trail.

Since there are several dams located along the river which will eventually be reconstructed the maximum flows are important in the development of project design flows required for determining the size of spillways.

(b) Control of Streamflow

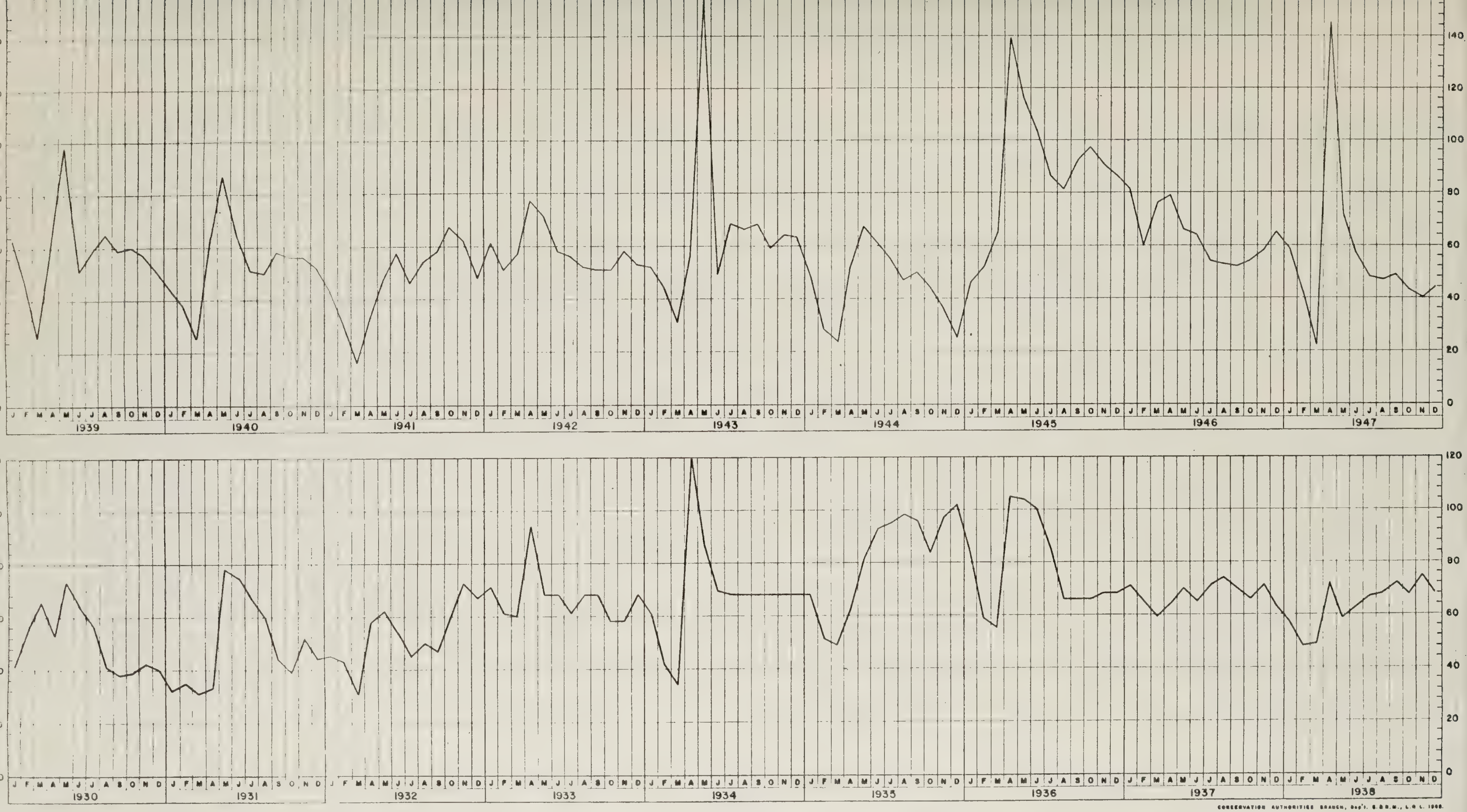
As noted earlier the flow from Stoney Lake into the Indian River is controlled by a small dam operated by the Trent Canal System. The dam, constructed in 1929, consists of a single 10-foot concrete sluiceway fitted with stop logs and concrete wingwalls.

The purpose of the dam is to regulate the flow into the Indian River. This is accomplished by raising the bottom stop log six inches which, with the normal head of approximately six feet of water, provides a discharge of 50 to 60 cubic feet per second (c.f.s.). This setting is normally left unchanged so that the discharge varies with the level of Stony Lake. The setting has been established over the years through discussion between the mill operators on the river and the Trent Canal System to try to maintain a minimum flow of 48 c.f.s.

There is no formal agreement guaranteeing this flow. Prior to the construction of the dam in 1929 the flow through the cut was uncontrolled.

(c) Streamflow Records

The Trent Canal office maintained flow records at the control dam for the period 1930 to 1947 and at Jermyn near Highway No. 7



HYDROGRAPHS

Gauge on Indian River at Gilchrist Bay

Mean monthly flows plotted from records maintained by Trent Canal System.

FIG. 5

for the period 1930 to 1937. It also maintained records of flow through the cut for a number of years prior to the construction of the control dam.

The flow records for the control dam at Gilchrist Bay are based on calculated dam discharge. The mean monthly flows for the period 1930 to 1947 have been plotted on Figure 5. Since the position of the stop logs is not changed the flow is dependent upon the level in Stony Lake. The level of Stony Lake varies between an elevation 766 feet in the winter and a maximum of elevation 771.78 (1928). Normal summer level is approximately 768 feet. The maximum mean monthly flow of approximately 150 c.f.s. occurred in 1943 and 1947. The maximum flow in 1947 was 315 c.f.s. Generally the summer flow is 40 to 60 c.f.s.

The maximum recorded flow through the cut prior to the construction of the dam was 2,085 c.f.s. in April 1922.

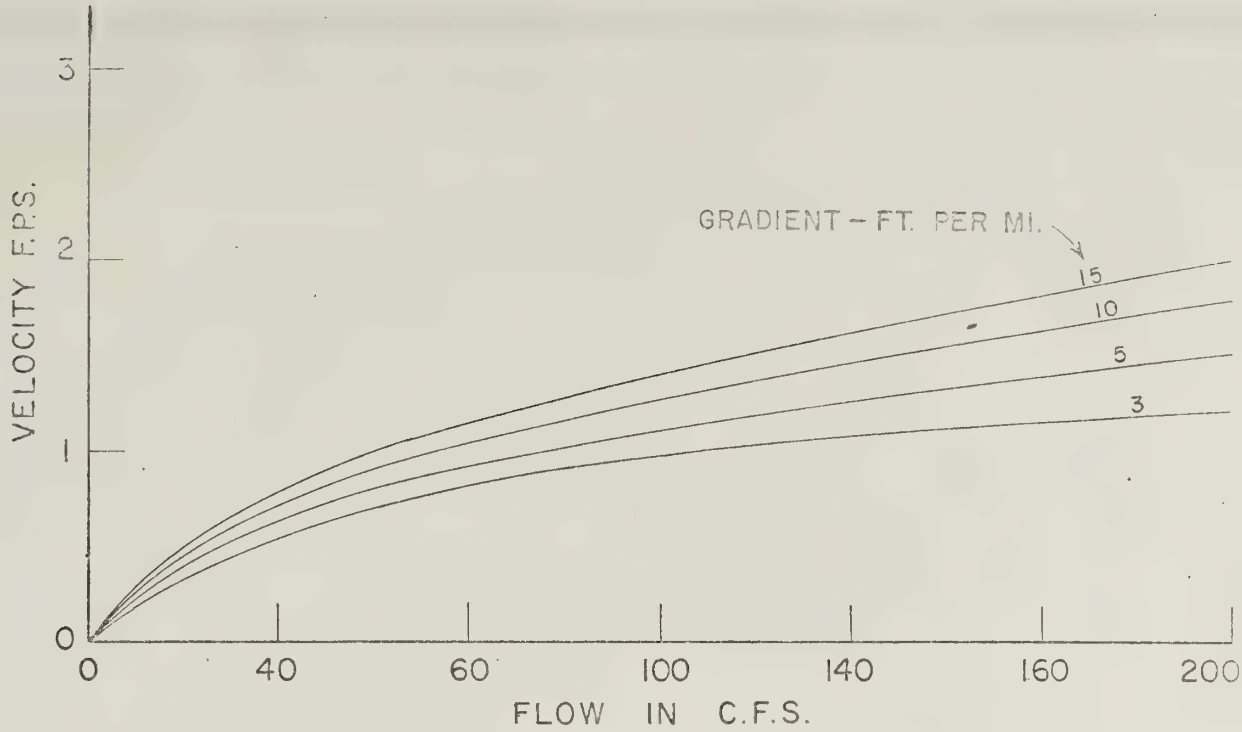
It is recommended that the Authority, as part of the plan for development, request that a streamflow guage be established on the river to keep a daily record of the flows.

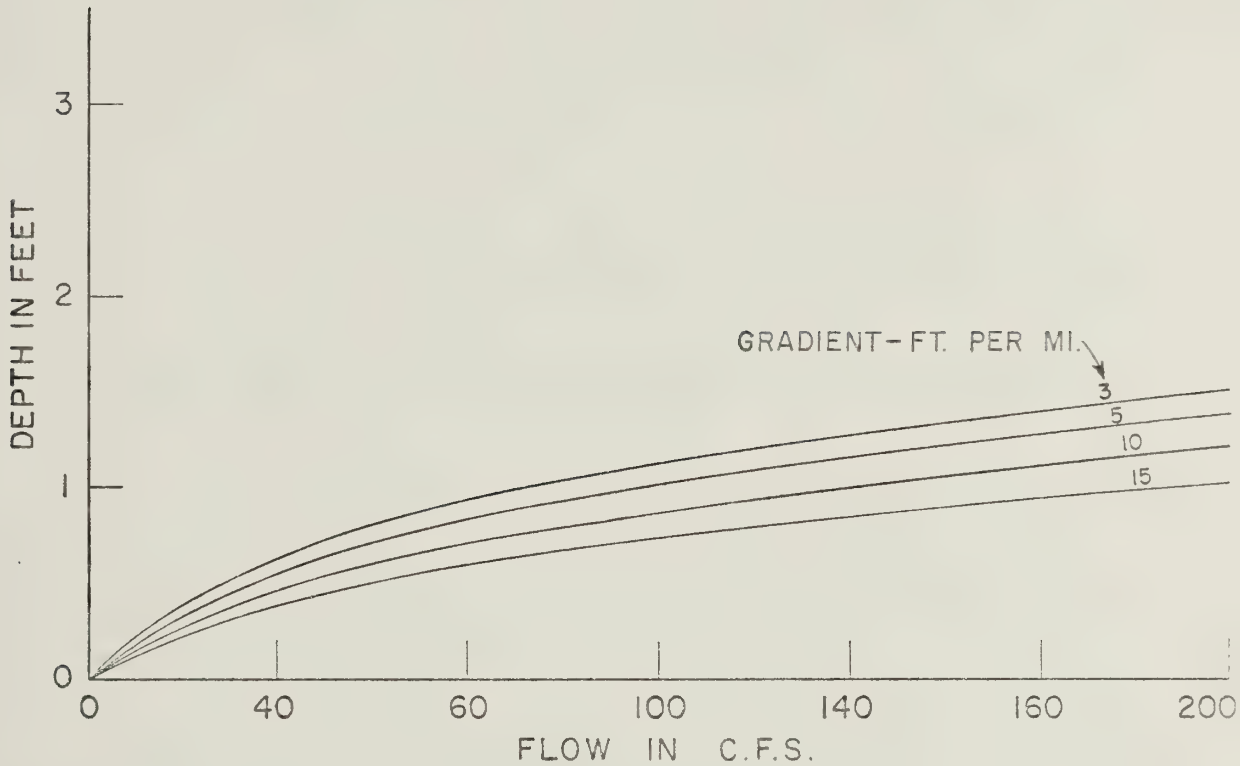
(d) Minimum Flows

The minimum flows released by the dam at Stony Lake are much greater than would be generated by the natural runoff from the watershed. Without the diversion the river would be dry, or nearly so, in most summers.

The hydrograph, Figure 5, indicates minimum flows in late winter, February or March, resulting from the reduced discharge from Stony Lake due to low water levels in the lake.

The low flows for the period of record 1930 to 1947 were analyzed, using the lowest average monthly flow for the summer period, June, July, August and September, for each year. This analysis indicates that once every 18 years one of the summer months will have an average flow below 40 c.f.s.





INDIAN RIVER

DEPTH, VELOCITY, GRADIENT AND FLOW RELATIONSHIPS

This does not illustrate the true relationship between natural uncontrolled events, runoff and time, because of the effect of the inlet control dam. It does illustrate, however, the condition to be expected if the control dam is operated in the same manner in the future.

The degree to which additional flow in the river will increase the depth will vary in different reaches depending upon the channel conditions and slope. Figure 6 illustrates the relationship between depth and slope for flows of 50,100 and 200 c.f.s. From Figure 6 it can be noted that increasing the flow has the largest effect on depth for the flatter reaches. For a reach with a drop of 10 feet per mile, which is roughly the average river gradient, a flow of 50 c.f.s. would give a depth of 0.6 feet and it would take an increase of flow to 140 c.f.s. to double the depth.

However, the gradient in many stretches is considerably flatter and the present flow, with some channel improvement work, would be sufficient to maintain an adequate depth for most years.

If the flow were increased, some would be lost in storage in Dummer Lake and in the channel. Because of this it would be impossible to predict how much the depth would be improved at specific points. This could best be determined by increasing the flow and examining the areas in question. In the case of Dummer Lake it may be necessary to construct a low weir at the out let to slightly increase the water level. The discharge from the dam and weir could be increased together to avoid loss of water in ponding.

Since the amount of water in the Otonabee Region is often critical for the maintenance of lake levels in the popular

resort areas, it is unlikely that a substantial increase in discharge from Stony Lake would be considered favourably in the near future. Every effort will be made in arranging a minimum flow of 60 c.f.s. to establish a navigable waterway.

(e) Design Flows

The "design flow" is the flow adopted as the basis for the design of control structures. For such structures as large dams, it is essential that the spillway be of sufficient capacity to pass safely the greatest flow that could be expected to occur at that point. For lesser control works such as small dams and channel improvements where serious flood damage would not result through failure of the structure smaller design flows may be acceptable. For spillway design several flows are normally considered. These are:

(i) 100-year - is defined as a flow that can be expected to occur on the average once every 100 years.

(ii) Maximum Observed - which is the greatest flow recorded on the stream under study.

(iii) Regional - which is the flow equivalent to the largest flood known to have occurred in the region.

(iv) Probable Maximum - defined as the greatest flow considered possible on the river.

Studies of runoff and stream flow for watersheds located on and adjacent to the Canadian Shield indicate that these watersheds do not generate high rates of runoff. The rate of runoff from the larger watersheds is generally less than 10 cubic feet per second per square mile (c.s.m.).

The purpose of the proposed dams is water level regulation. Downstream flooding is not a serious problem. Based on the above considerations for the project design flow for the

preliminary planning as outlined in this report was based on a runoff rate of 20 c.s.m. plus maximum flow of record from Stony Lake.

At the time of final design this flow should be reviewed and additional studies made if conditions and more recent hydrologic data warrant them.

4. REMEDIAL MEASURES

(a) General

The proposed remedial measures are directed towards increasing the depth of water in the stream to a minimum of one foot. The simplest way of accomplishing this objective is to increase the flow in the stream. It has the advantages of no cost to the Authority, while preserving the natural conditions of the stream.

Unfortunately, as noted in Chapter 3, increasing the streamflow is limited by the water requirements for the Trent Canal System and resort lakes in the area. It is, therefore, necessary to resort to remedial works along the stream to provide the desired depth in the channel. The extent of these works will depend upon the degree to which the flow can be increased and the layout of the proposed routes.

Because of the above considerations, only typical measures have been proposed, which can be altered according to site conditions The measures proposed are:

(1) Channel improvements,

(2) Construction of small seasonal and permanent rock-filled dams,

(3) Reconstruction of existing dams.

(b) Channel Improvements

This work would involve the removal from the channel of boulders, log jams and debris which would hamper the safe passage of small boats.

Most of the shallow reaches could be improved by this method. In many places a considerable amount of loose one-man sized boulders lie on the stream bottom. These boulders could be removed manually to form a stone-free channel for the canoe. However, since the loose boulders and debris tend to increase the water depth by restricting the flow, the clearing should be restricted to the minimum required width of channel.

Log jams exist at several locations, particularly above and below the damsite at Keene and downstream from Little Joe Lake. These jams create small ponds but make it necessary for the canoeist to portage. Careful site inspection should be made to decide if the removal of the jam will create a shallow reach upstream. In some cases it may be advisable to leave the log jam or make use of it in the construction of a small dam.

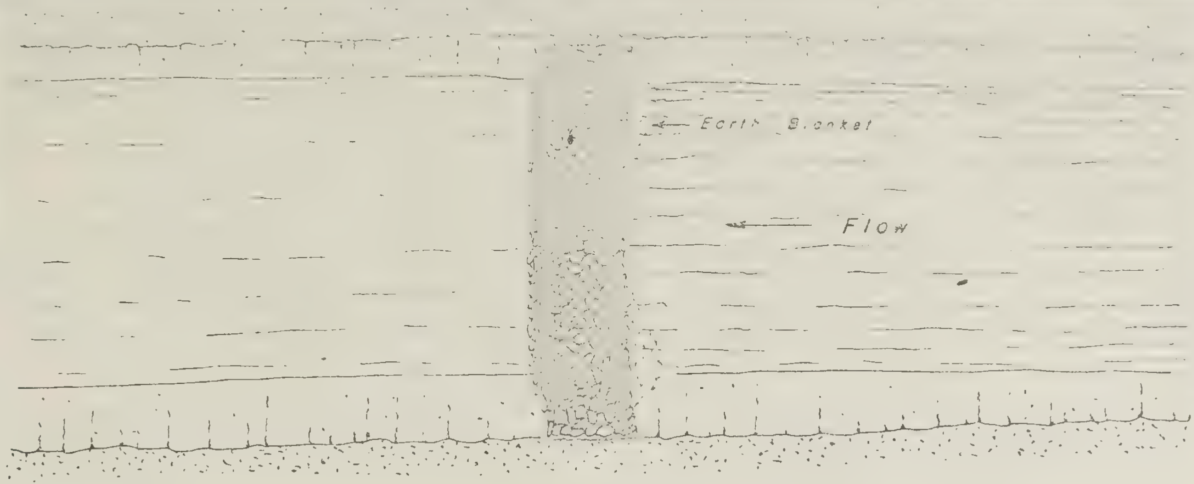
(c) <u>Small Dams</u>

Typical low head overflow type seasonal dams and permanent rock-filled dams have been suggested in Figures 7 and 8 respectively. The seasonal dams could be used at locations where there was a sound rock foundation and the rock-filled dams where the stream bed is less stable.

The seasonal dams would consist of I-beams set in either the bedrock or a poured concrete foundation. These would be fitted with stop logs which would be removed each fall and replaced in the spring. The estimated cost of this type of structure, four feet high on sound bedrock, would be in the order of $25 to $30 per linear foot. Those requiring a concrete slab would be considerably more expensive.

Two types of rock-filled dams have been proposed which could be constructed manually using stones from the area which could be moved by one man. An earth blanket with a plastic liner would probably be necessary along part of the upstream face to prevent the water from flowing through the dam and raise the level of the top of the dam.

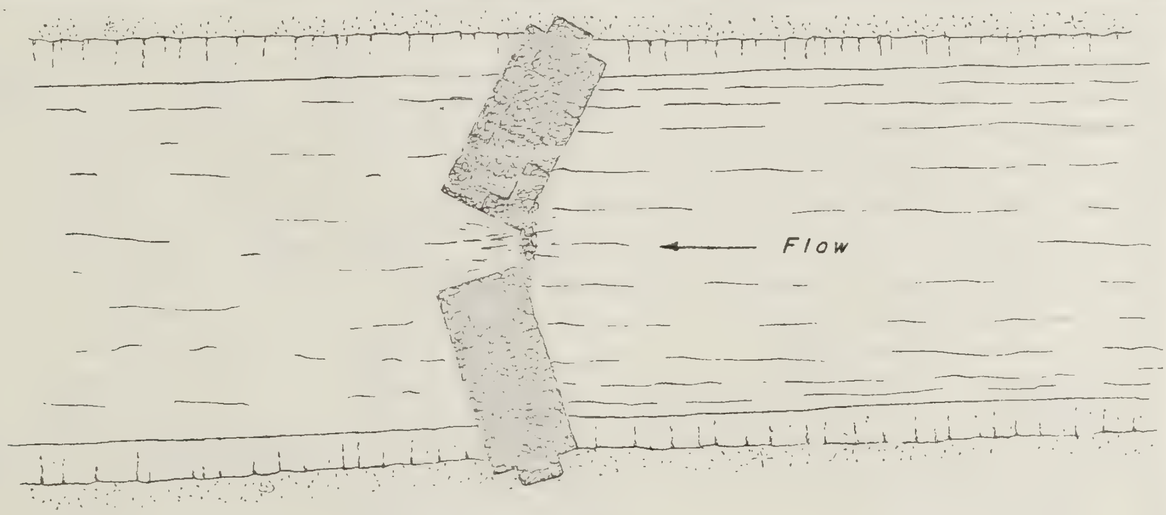
The gabion dam is similar to the rock dam. The gabion will allow the use of smaller stones and add to the stability of the structure. The estimated cost for constructing four-foot high structures of this type using local labour and materials is $1,000 to $2,000 per site.



PLAN

ROCK DAM

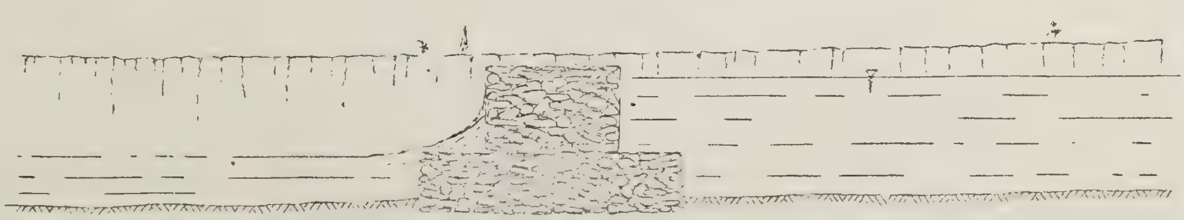
TYPICAL SECTION



PLAN

GABION DAM

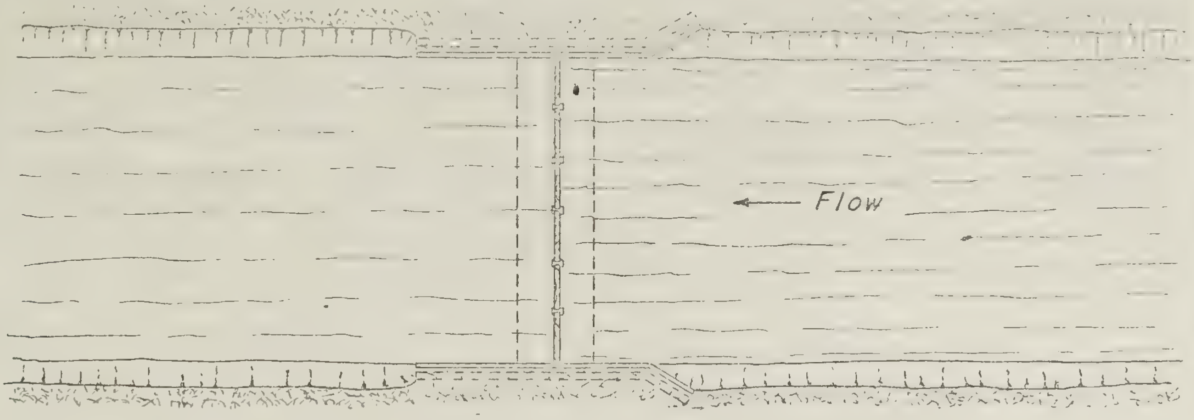
TYPICAL SECTION



TYPICAL ROCK-FILLED DAMS
(EARTH FOUNDATION)

CONSERVATION AUTHORITIES BRANCH, Dep't. E.&R.M., L.R.I. 1961

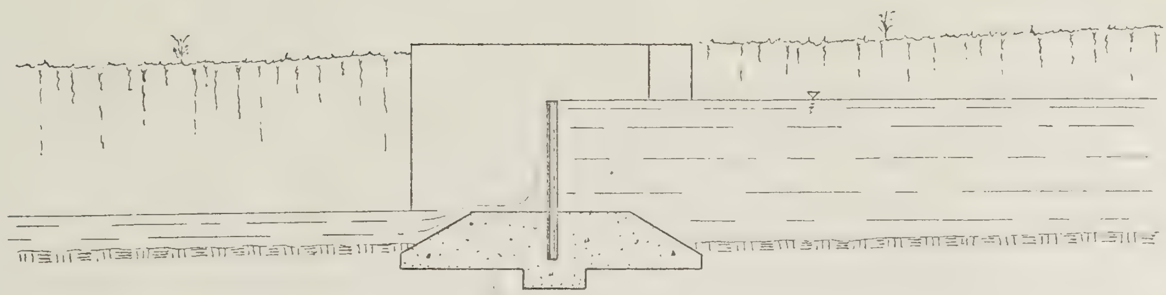
FIG. [illegible]

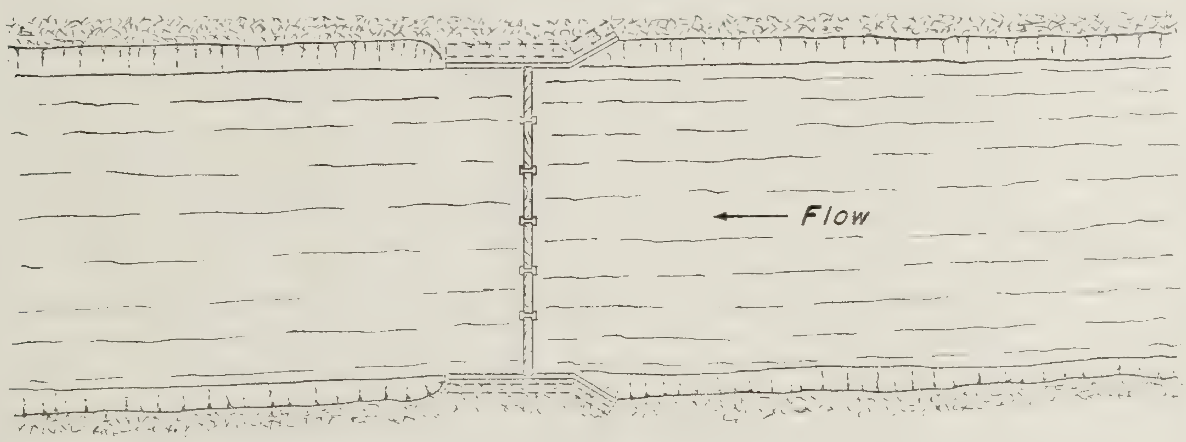


PLAN

I BEAMS EMBEDDED IN CONCRETE FOUNDATION

TYPICAL SECTION

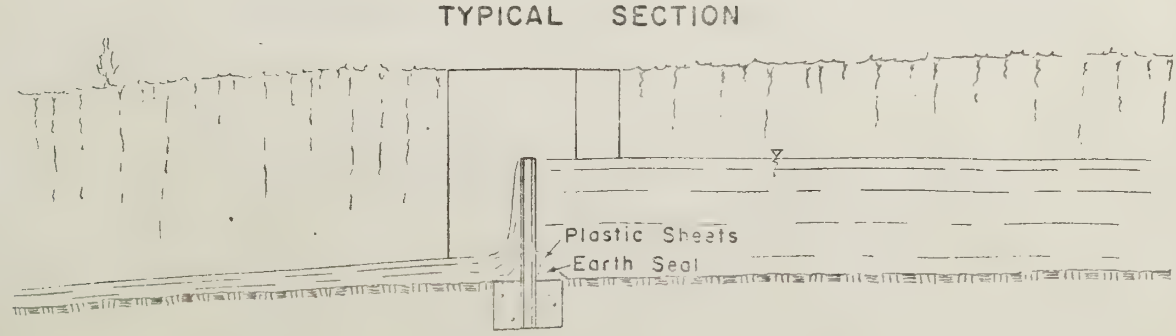




PLAN

I BEAMS EMBEDDED IN BEDROCK

TYPICAL SECTION



TYPICAL SEASONAL DAMS
(ROCK FOUNDATION)

CONSERVATION AUTHORITIES BRANCH,

FIG. 7

It is recommended that the height of the dams and weirs be limited to a maximum of six feet to avoid stability problems and enable the work to be done by the Authority's own forces or other interested local groups.

The distance a dam will flood upstream will depend upon the stream gradient at that point. If the stream gradient is six feet per mile, two four-foot high dams would be required to provide a minimum depth of one foot throughout the reach. Where the gradient is steep the effect of the dam is correspondingly reduced and the cost per mile to maintain a depth of one foot is increased.

The disadvantage of this method, of course, is that the number of portages will be increased. This could be overcome to some extent by leaving a narrow opening or passage through the structure. This arrangement would be similar in principle to the sluices used to pass logs but the high velocity through the opening would greatly hamper upstream travel. However, it would provide an added thrill for those travelling downstream.

(d) Reconstruction of Existing Dams

There are several old dams located along the river. If these dams collapsed and were not replaced, the length of shallow reaches would be increased considerably. Therefore, every effort should be made to preserve or restore these dams. The permanent pools created by some of the dams could form the nucleus of a conservation area or be maintained as a community pond, depending upon local needs.

A list of the dams and their present condition is given in Table III.

TABLE III

Dam	Present Condition	Ownership
Payne's	Out	Private
Warsaw	Poor	Private
Cruickshank	Under repair	Private
Hope	Poor	Authority
Lang	Under repair	Authority
Keene Station	Out	Private

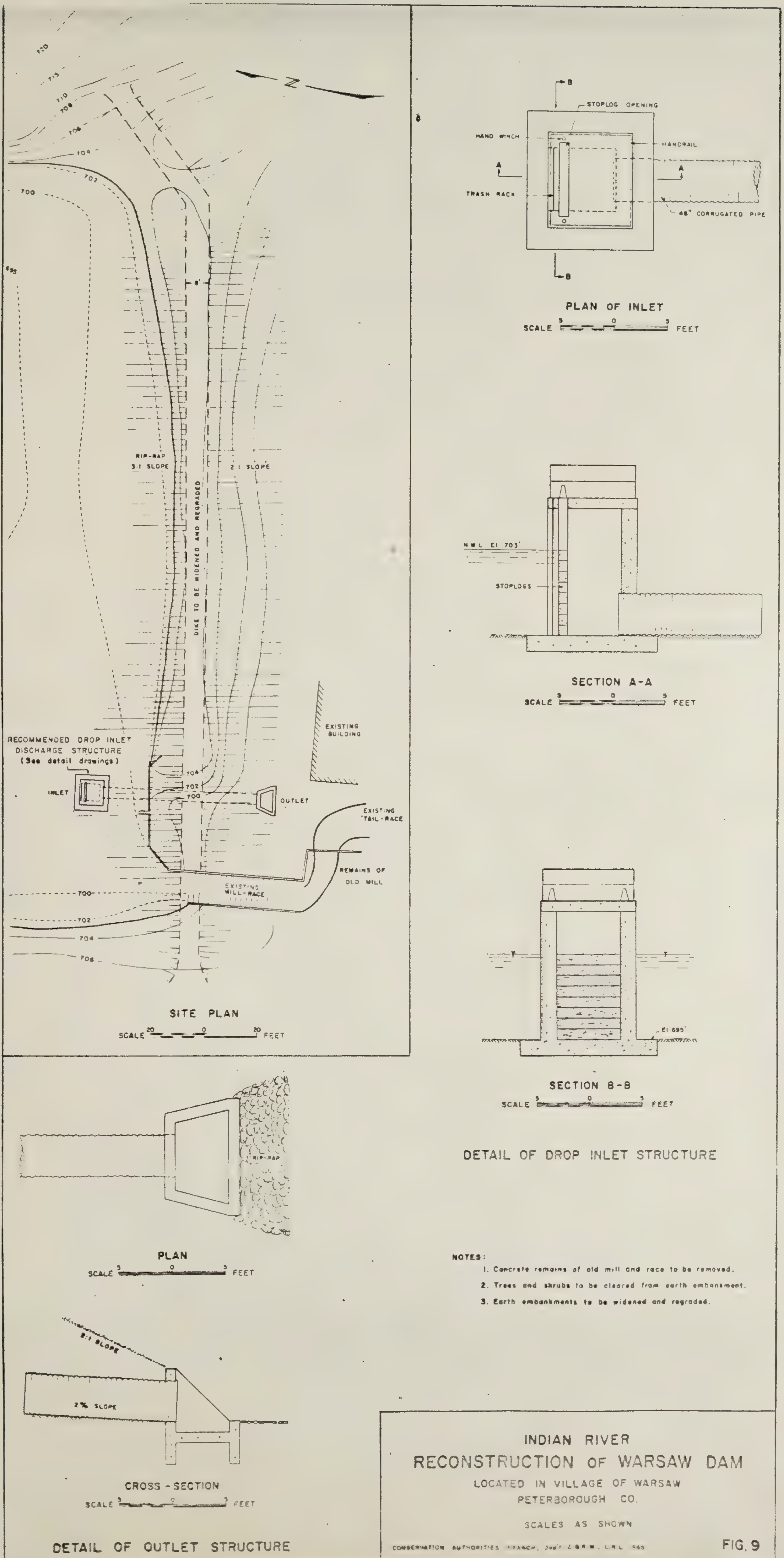
Site surveys were carried out for all the dams and preliminary designs were prepared for the Warsaw and Lang dams. These are shown on Figures 9 and 10 respectively.

The existing dam at Warsaw is located on a by-pass channel with the main channel located about one-quarter mile to the east. The water level in the pool is controlled by a low weir located on the main river channel. This is an ideal arrangement since the high flood flows can be diverted down the main channel without affecting the dam.

The proposed rehabilitation calls for the removal of the remains of the old mill and mill-race and the construction of a low flow conduit with a concrete drop-inlet structure fitted with stop logs. Further investigation is required regarding the piggery located immediately downstream from the dam. If the costs are not prohibitive, it should be removed.

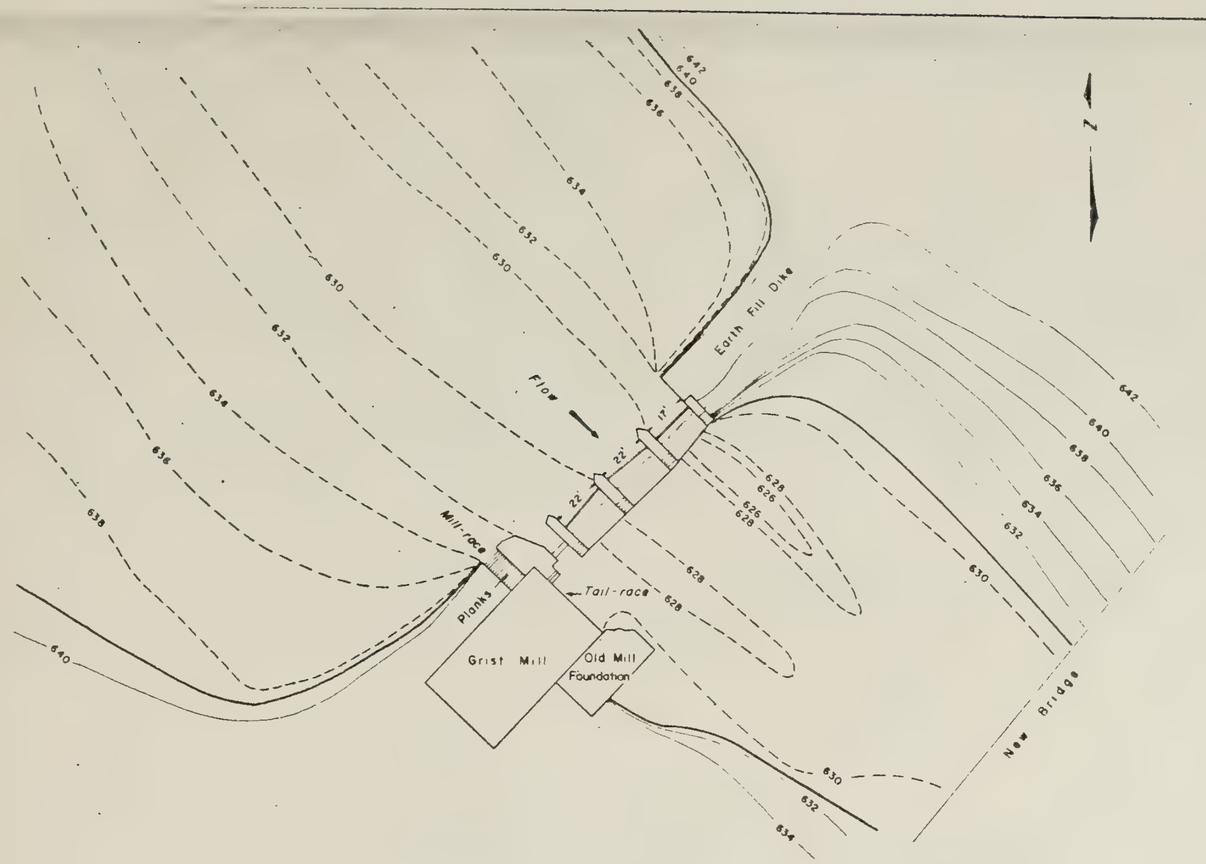
The existing dike would be regarded and rip-rap placed on the upstream slope. The downstream side would be reseeded with grass or sodded.

Further studies are required to insure that the main channel has sufficient capacity to pass the design flow without increasing the lake level above the top of the dam.



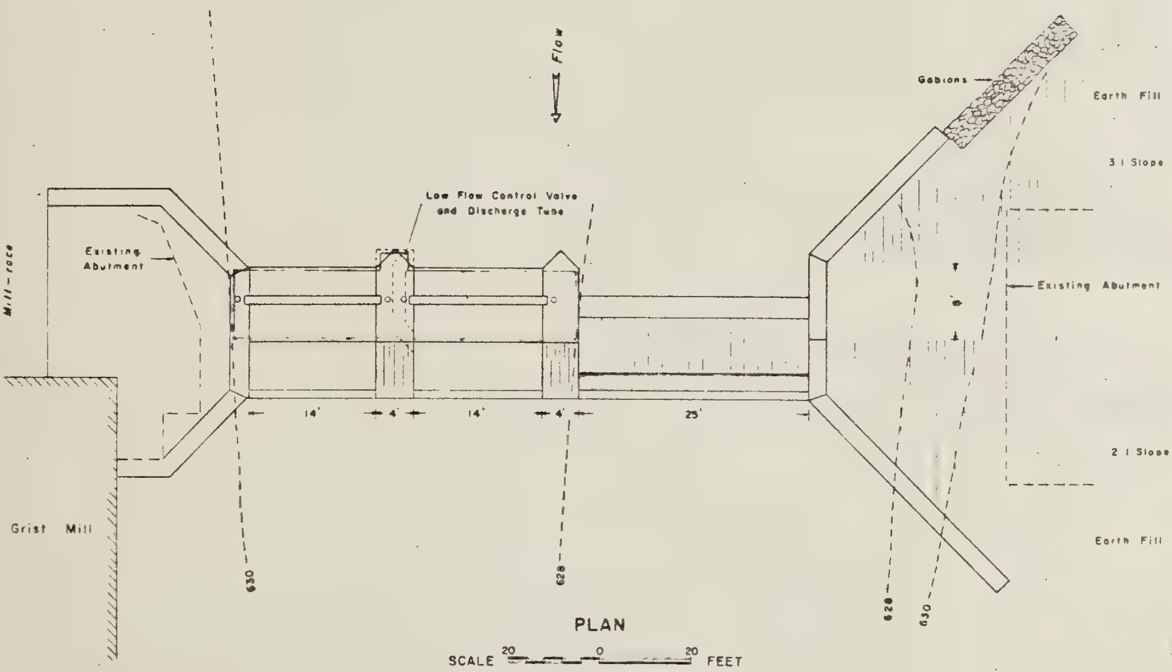
720
715
710
708
706
704
702
700
695
N
8'
RIP-RAP
3:1 SLOPE
2:1 SLOPE
DIKE TO BE WIDENED AND REGRADED
EXISTING BUILDING
RECOMMENDED DROP INLET DISCHARGE STRUCTURE
(See detail drawings)
INLET
OUTLET
EXISTING TAIL-RACE
REMAINS OF OLD MILL
EXISTING MILL-RACE
SITE PLAN
SCALE 20 0 20 FEET
STOPLOG OPENING
HAND WINCH
HANDRAIL
TRASH RACK
48" CORRUGATED PIPE
A
B
PLAN OF INLET
SCALE 5 0 5 FEET
N.W.L. El 703'
STOPLOGS
SECTION A-A
SCALE 5 0 5 FEET
El 695'
SECTION B-B
SCALE 5 0 5 FEET
DETAIL OF DROP INLET STRUCTURE
RIP-RAP
PLAN
SCALE 5 0 5 FEET
2:1 SLOPE
2% SLOPE
CROSS-SECTION
SCALE 5 0 5 FEET
DETAIL OF OUTLET STRUCTURE
NOTES:
1. Concrete remains of old mill and race to be removed.
2. Trees and shrubs to be cleared from earth embankment.
3. Earth embankments to be widened and regraded.
INDIAN RIVER
RECONSTRUCTION OF WARSAW DAM
LOCATED IN VILLAGE OF WARSAW
PETERBOROUGH CO.
SCALES AS SHOWN

FIG. 9



PLAN OF EXISTING SITE AND DAM

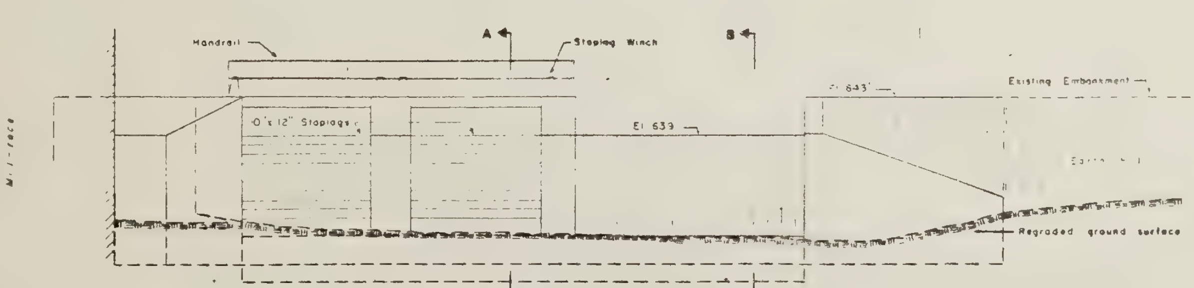
SCALE 40 0 40 80 FEET



PLAN

SCALE 20 0 20 FEET

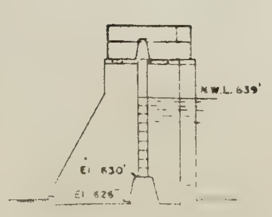
PROPOSED DAM



ELEVATION

(LOOKING UPSTREAM)

SCALE 20 0 20 FEET



SECTION A-A

SCALE 5 0 5 FEET

INDIAN · RIVER

RECONSTRUCTION OF LANG DAM

PLANS, ELEVATION AND SECTIONS

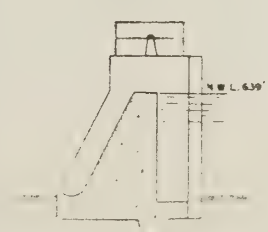
LOT 19, CON. VI, TWP. OF OTONABEE

PETERBOROUGH CO

SCALES AS SHOWN

CONSERVATION AUTHORITIES BRANCH, DEPT. E.& R.M. ... 1965

FIG. 10



SECTION B-B

SCALE 5 0 5 FEET

The existing dam at the Lang Mill would be replaced with a concrete gravity structure with two fourteen foot sluiceways and an overflow section. The sluiceways would be fitted with ten by twelve inch stop logs which could be removed by manually operated winches located on the deck.

No det ails were prepared for the rehabilitation of the Cruick-shank, Hope and Keene Station dams.

5. PROPOSED WORK

(a) General

The plan for the remedial works is based on the premise that a depth of one foot of water will provide an acceptable route on the Indian River. The proposed measures are considered to be minimal and, apart from the larger dams, are designed with the thought that the work would be undertaken by the Authority or other local groups. The costs are relatively high, but the nature of the scheme is such that the work may be carried out in stages over a period of years as funds permit.

(b) Location and Type of Remedial Measures

The present channel depths under normal summer conditions are outlined in Table IV.

TABLE IV

Depth	Approx. Length Miles *	Per Cent of Total River
Greater than four feet		
- mill ponds and lakes	5.4	21
- river	3.6	14
Between four and one foot	6.0	23
Less than one foot	11.0	42
Totals	26.0	100

* Length computed from aerial photographs and field inspections

From the above it may be noted that 42 per cent or 11 miles of the river has a depth of less than one foot. Thus it is evident that a considerable amount of work will be necessary to obtain the desired conditions.

In order to avoid the problems from flooding private land the heights of the proposed dams have been limited so that the river would be contained within its banks throughout the respective reaches. The suggested remedial measures for various reaches are described briefly in the following sections.

(i) Reach 1

This short reach is located immediately downstream from the control dam at Stony Lake. Since a portage will be required around the dam, this reach should be included in the portage.

(ii) Reach 2

The reach of 12,000 feet starting at the lower end of Dummer Lake consists of alternative deep and shallow sections. Channel improvements and weirs will be required.

(iii) Reach 3

The length of this reach is 1,000 feet with a drop of approximately five feet. Because the reach is short with a steep gradient it is recommended that a portage be established.

(iv) Reach 4

With a drop of 16 feet in less than one mile this is an extremely difficult reach. Weirs every 1,000 feet would be required to make it navigable, at considerable cost. However, the upper 1,800 feet could be improved with a single weir, leaving a portage of 2,000 feet to Payne's sawmill pond. One difficulty with a weir in this location would be the flooding of a ford at the upper end of this reach which is used as a crossing on a rather marginal farm. This farm should be acquired for Authority Forest, as recommended in the 1964 report.

(v) Reach 5

These are short isolated sections which require channel clearing.

(vi) Reach 6

Reach 6 includes a shallow area upstream of the caves at the Warsaw Conservation Area and the falls below the caves. Deeper water for swimming is desirable in the upper portion and a weir above the falls would serve a double purpose. A portage of about 1,000 feet will be necessary to pass the falls.

(vii) Reach 7

This critical reach of approximately 6,000 feet is located at the village of Warsaw. By leaving the main channel and taking the bypass into Warsaw, which would be one of the main stops for refreshments and supplies, the length of the portage required could be shortened to about 3,8000 feet.

(viii) Reach 8

This is a short rocky reach. It is recommended that the boulders and rocks be removed by hand. If it is still difficult for navigation then a portage should be established along the reach.

(ix) Reach 9

This is a long critical reach with a drop of eight feet over a length of 12,800 feet. It starts immediately below the Cruickshank Dam. The river banks vary between two and three feet in height and three low weirs will be required.

(x) Reach 10

This reach is approximately 1,400 feet in length with a drop of one foot. The depth varies throughout the reach. Remedial measures consist of the manual removal of boulders and rock.

(xi) Reach 11

This reach has a flat bottom and is roughly a mile in length with a fall of approximately seven and a half feet. The construction of two weirs, each about four feet high would be required to make this reach navigable.

(xii) Reach 12

This is a short shallow reach immediately downstream from the Hope Dam. Since it is necessary to portage around the dam this reach should be included in the portage.

(xiii) Reach 13

This reach is just under a mile in length with a fall of roughly five feet. Throughout the reach the banks are low and there are numerous boulders and large rocks strewn along the river bottom which is mainly bedrock. In some areas the

removal of the boulders and rocks is all that is required. Along with the channel clearing it is estimated that three small dams will be required.

(xiv) Reach 14

The length of this section is approximately 2,200 feet with a drop of roughly five feet. The elevation to which the water level in the pool above the abandoned Keene Dam can be raised is limited by the possibility of flooding at Keene Station and along the tributary just to the east of it.

It is recommended that a low dam be incorporated into the old abandoned dam at Keene and that two additional dams of two to three feet in height be constructed between the pool at this dam and Keene Station.

A log jam in the middle of the reach should be removed.

(xv) Reach 15

The length of this reach is approximately 4,200.feet with a four-foot drop. The channel, which has a soft silty bottom and low banks on both sides, contains numerous large boulders and stones, particularly in some areas of shallow water. The height to which the water level can be raised is limited by the low banks. To keep the water within the banks two low dams about two feet high are recommended.

II DETAILS OF SCHEME

(b) Purpose of Scheme

The Otonabee Region Conservation Authority proposes to develop a Canoe Trail throughout the length of the Indian River.

While the primary purpose of this scheme is recreation, in the form of canoeing, there will be many side effects evident as a result of the various development works along this canoe route.

It is obvious that the re-construction and repairs of the four dams along the Indian River will be an asset to the surrounding area from the point of view of increasing the ground water supply and improving surface water supplies for farmers adjacent to the Indian River.

The proper development of this River as a canoe trail will help to encourage the tourist industry to the central part of the Otonabee Region. While it is not proposed to increase the depth of water sufficient for powered craft, we do hope to bring encouragement to the sport of canoeing. As it will be seen in the recommendations for improving the quantity of water in the river, much labour will be required to construct the recommended weirs and perform the recommended channel clearing. It is proposed to use local labour to carry out this work, as far as is possible. Much of the work will have to be done by hand in the water, as it would be impractical to use mechanized equipment, especially in areas where the river bed tends to be soft.

The Otonabee Region Conservation Authority proposes to carry out the recommended development work over a period of several years beginning with 1968.

Existing grants under the Conservation Authorities' Act provide for only a 50% subsidy to the Authority. The Otonabee Region Conservation Authority feels this project to be extremely important to the development of the Otonabee watershed. It is for this reason therefore, that grants amounting to 90% of the total cost of the scheme are being requested. While it is not proposed to acquire lands adjacent to the Indian River, it will be necessary to acquire land about the four dams which are recommended in the report. At the location of each of the weirs in the report, it is proposed to acquire only easements for the erection of these weirs or temporary dams at each site.

II DETAILS OF SCHEME

(c) Costs

1. Weirs and Channel Improvements

The total estimated cost to carry out the developments along the river as outlined in the following chart is $56,000. This would average about $2,000 per mile for the 26 miles of channel.

TABLE V

REMEDIAL MEASURES AND ESTIMATED COSTS

Reach		Remedial Measure		Estimated Cost Dollars
No.	Length-Ft.	Type	No. Required	
1.	300	Portage		
2.	12,000	Weirs and Channel Clearing		10,000
3.	1,000	Portage		
4.	(a) 1,800	Weir	1	3,000
	(b) 2,000	Portage		
5.	300	Channel Clearing		200
6.	(a) 2,000	Weir	1	3,000
	(b) 1,000	Portage		
7.	3,800	Portage		
8.	500	Channel Clearing		300
9.	12,800	Weirs	3	9,000
10.	1,400	Channel Clearing		500
11.	5,000	Weirs	2	6,000
12.	1,000	Portage		
13.	5,100	Weirs and Channel Clearing	3	9,000
14.	2,200	Weirs	3	9,000
15.	4,200	Weirs	2	6,000
			Total	$56,000

2. Dams

The estimated cost of rehabilitating the existing dams is $155,000.

In addition, land will be acquired around the perimeter of each of these reservoirs to protect the waters of the reservoir. This is estimated to cost $64,000.

TABLE VI

	Rehabilitation	Land Acquisition	Total
Warsaw Dam	25,000	20,000	45,000
Cruickshank Dam	35,000	20,000	55,000
Hope Dam	50,000	7,000	57,000
Lang Dam	45,000	17,000	62,000
	155,000	64,000	219,000

3. Total Cost

Weirs and Channel Improvements	56,000
Large Dams	219,000
Total Cost	275,000

II DETAILS OF SCHEME

(d) Financing

1. Cost

Total Cost	$275,000	
A.R.D.A. share - 90%		$247,500
O.R.C.A. share - 10%		27,500
		$275,000

It is proposed to phase the proposed work over a period of years to be completed in phases according to the following plan.

TABLE VII

Phase	Location of Work	Remedial Measures	Cost	
1.	Warsaw Caves to Hwy. 7	4 weirs	12,000	
		Channel clearing	300	
		Warsaw Dam Rehab.	25,000	
		Warsaw Dam acq.	20,000	57,300
2.	Hwy. 7 to Lang Dam	2 weirs	6,000	
		channel clearing	500	
		Hope Dam Rehab.	50,000	
		Hope Land acq.	7,000	63,500
3.	Lang Dam	Lang Dam Rehab.	45,000	
		Lang Land Acq.	17,000	62,000
4.	Lang Dam to Rice Lake	8 weirs	24,000	
		Cruickshank Dam Acq.	20,000	44,000
5.	Stoney Lake to Warsaw Caves	4 weirs	12,000	
		channel clearing	1,200	
		Cruickshank Dam Rehab.	35,000	48,000
		TOTAL		275,000

2. Benefiting Municipalities

It is proposed to name all member municipalities of the Otonabee Region Conservation Authority as benefiting. As such, each municipality will be levied in proportion to the population of each municipality in the watershed.

III AUTHORITY APPROVAL AND REQUESTS

(A) Motions November 10, 1966

Moved by R.L. Bishop
Seconded by Glenn Brown

THAT the recommendations of the Indian River Canoe Trail Study be incorporated as Scheme # 21 of the Authority;

AND FURTHER,

THAT the Otonabee Region Conservation Authority request the Minister of the Department of Energy and Resources Management for approval of Scheme # 21, as required by Section 16 of the Conservation Authorities Act;

AND FURTHER,

THAT the Otonabee Region Conservation Authority request the Minister of the Department of Agriculture and Food for approval of Scheme # 21, as an ARDA project as required by the Agricultural Rehabilitation and Development Act;

AND FURTHER,

THAT a grant of 90% of the total cost be requested from the Department of Agriculture and Food, according to Section 42 (1) of the General Agreement;

AND FURTHER,

THAT all municipalities in the watershed be named benefiting and as such, the Authority share to be levied in the same proportion as the population of each in the watershed.

(B) Letters of Request

1. Minister of Energy & Resources Management
2. Minister of Agriculture and Food

IV LAND VALUES

(A) Land Acquisition

Values stated for the acquisition of the dams and surrounding land are estimated on the basis of similar transactions made by the Otonabee Region Conservation Authority in consideration of the present rate of appreciating land values.

The foregoing estimates of land acquisition include a sufficient amount for legal, surveys and associated expenses.

As properties are acquired, they will be evaluated by an accredited appraiser, Mr. Richard S. Roberts, prior to final formal approval of acquisition.

(B) Easements and Flooding Rights

Negotiations for easements and flooding rights on properties of adjacent land owners are anticipated to reveal nominal costs and thus are considered a part of the overall legal and survey costs.